

Claims

- [c1] 1. A method of MR data acquisition comprising the steps of:
sampling peripheral regions of k-space at a pre-selected temporal rate;
waiting a predetermined period of time before sampling a next region of k-space if the next region of k-space is a center region of k-space,
wherein the center region is sampled at a higher temporal rate; otherwise
sampling the next region of k-space at the pre-selected temporal rate.
- [c2] 2. The method of claim 1 wherein the predetermined period of time is a function of peripheral region distance from the center region of k-space.
- [c3] 3. The method of claim 2 further comprising the step of increasing the predetermined period of time as the peripheral region distance from the center region of k-space increases.
- [c4] 4. The method of claim 1 further comprising the step of maintaining steady state of the MR signal to minimize signal intensity variation.
- [c5] 5. The method of claim 1 further comprising the step of playing out a series of zero-encoding pulses during the predetermined period of time.
- [c6] 6. An MRI apparatus comprising:
a magnetic resonance imaging (MRI) system having a plurality of gradient coils positioned about a bore of a magnet to impress a polarizing magnetic field and an RF transceiver system and an RF switch controlled by a pulse module to transmit RF signals to an RF coil assembly to acquire MR images; and
a computer programmed to:

segment k-space into a center region and a number of peripheral regions;
determine a distance of each peripheral region from the center region;
sample an MR signal to fill the center region at a faster sampling rate than used to sample each peripheral region; and
delay sampling of the MR signal to fill the center region as a function of the distance of an immediately preceding sampled peripheral region from the center region.

- [c7] 7. The MRI apparatus of claim 6 wherein the computer is further programmed to increase the delay in sampling as the distance of the immediately preceding sampled peripheral region from the center region increases.
- [c8] 8. The MRI apparatus of claim 7 wherein the increase in delay is a linear increase in delay time as the distance of the immediately preceding sampled peripheral from the center region increases.
- [c9] 9. The MRI apparatus of claim 8 wherein delay time after sampling a first peripheral region is a multiple of that observed after sampling of a second peripheral region.
- [c10] 10. The MRI apparatus of claim 6 wherein the computer is further programmed to play out a series of approximately zero-encoding pulses along one of a slice selective axis and phase-encoding axis during the delay in sampling.
- [c11] 11. The MRI apparatus of claim 6 wherein a first peripheral region is

closer to the center region than a next peripheral region.

- [c12] 12. The MRI apparatus of claim 6 wherein amplitude of one of phase-encoding gradient pulses and slice-encoding gradient pulses increases as the distance of each peripheral region from the center region increases.
- [c13] 13. The MRI apparatus of claim 6 wherein the computer is further programmed to acquire 3D volumetric data during passage of an intra-vascular contrast agent through a patient.
- [c14] 14. A computer readable storage medium having stored thereon a computer program to reduce image intensity variation during MR data acquisition, the computer program including a set of instructions that when executed by a processor causes the processor to:
- partition k-space into a plurality of partitions wherein one partition corresponds to a center of k-space and the other partitions correspond to peripheral regions of k-space;
 - determine a distance from the center of k-space for each peripheral region; and
 - delay the sampling of the center k-space by a predetermined value that is a function of the distance an immediately preceding sampled peripheral region is from the center of k-space.
- [c15] 15. The computer readable storage medium of claim 14 wherein the set of instructions further causes the processor to play out a number of minimal-encoding pulses prior to the sampling of the center of k-space.

- [c16] 16. The computer readable storage medium of claim 15 wherein the number of zero-encoding pulses played out prior to sampling of the center of k-space increases as the distance from the center of k-space an immediately preceding peripheral region of k-space increases.
- [c17] 17. The computer readable storage medium of claim 16 wherein the number of zero-encoding pulses varies linearly as a function of distance of data acquisition from the center of k-space.
- [c18] 18. The computer readable storage medium of claim 15 wherein a length of each zero-encoding pulse causes a delay in acquisition before the center of k-space sufficient to cause a disruption to steady-state dynamics of transverse magnetization.
- [c19] 19. The computer readable storage medium of claim 15 wherein each minimal-encoding pulse has a zero amplitude.
- [c20] 20. The computer readable storage medium of claim 15 wherein each zero-encoding pulse is one of a slice selective gradient pulse and a phase-encoding gradient pulse.
- [c21] 21. The computer readable storage medium of claim 14 wherein the set of instructions further causes the processor to sample the center of k-space at a faster rate than each peripheral region.